

WHAT IS CLAIMED IS:

1. A cushioning device for a footwear, comprising:
  - a) a chamber including a magnetically responsive fluid; and
  - b) a magnetic member for applying a magnetic field to said fluid thereby varying the viscosity thereof.
2. The cushioning device of Claim 1, wherein:
  - a) the viscosity of said fluid is greater than the viscosity of a fluid selected from the group consisting of water, glycerine, hydraulic oil, and mineral oil.
3. The cushioning device of Claim 1, further comprising:
  - a) a weight sensor for determining the weight of a user of a footwear.
4. The cushioning device of Claim 1, further comprising:
  - a) a movement sensor for determining the movement of a footwear.

5. The cushioning device of Claim 3, further comprising:
  - a) a control unit for receiving information from said weight sensor and relaying a signal to said magnetic member to apply a magnetic field.
6. The cushioning device of Claim 1, wherein:
  - a) said fluid comprises core particles of a magnetic material.
7. The cushioning device of Claim 6, wherein:
  - a) a plurality of said core particles are attracted to form a magnetically connected structure when a magnetic field is applied to said fluid.
8. The cushioning device of Claim 7, wherein:
  - a) said structure comprises generally rectilinear or bent configuration.
9. The cushioning device of Claim 6, wherein:
  - a) said core particles comprise coated particles.

10. The cushioning device of Claim 6, wherein:
  - a) said core particles have an average diameter of about 1 nm to 100  $\mu\text{m}$ .
11. The cushioning device of Claim 10, wherein:
  - a) said core particles have an average diameter of about 1 nm to 10  $\mu\text{m}$ .
12. The cushioning device of Claim 11, wherein:
  - a) said core particles have an average diameter of about 10 nm to 5  $\mu\text{m}$ .
13. The cushioning device of Claim 6, wherein:
  - a) said magnetic material is selected from the group consisting of iron, iron oxide, cobalt, cobalt oxide, nickel, nickel oxide, an alloy, and a combination thereof.
14. The cushioning device of Claim 6, wherein:
  - a) said core particles comprise a coating of a surfactant.

15. The cushioning device of Claim 14, wherein:
- a) said surfactant is selected from the group consisting of polyethylene glycol, lecithin, oleic acid, Surfynol<sup>®</sup>, and a combination thereof.
16. The cushioning device of Claim 6, wherein:
- a) said core particles comprise a coating selected from the group consisting of a ceramic material, a metallic material, a polymer material, and a combination thereof.
17. The cushioning device of Claim 16, wherein:
- a) the coating is selected from the group consisting of silica, gold, silver, platinum, steel, cobalt, carbon, polyethylene glycol, polystyrene, dextran, and a combination thereof.
18. The cushioning device of Claim 6, wherein:
- a) said core particles comprise first and second successive coatings.

19. The cushioning device of Claim 6, wherein:
- a) said first coating comprises a coating of a surfactant; and
  - b) said second coating comprises a coating of a material selected from the group consisting of a ceramic material, a metallic material, a polymer material, and a combination thereof.
20. The cushioning device of Claim 19, wherein:
- a) said surfactant is selected from the group consisting of polyethylene glycol, lecithin, oleic acid, Surfynol<sup>®</sup>, and a combination thereof.
21. The cushioning device of Claim 20, wherein:
- a) said second coating is selected from the group consisting of silica, gold, silver, platinum, steel, cobalt, carbon, polyethylene glycol, polystyrene, dextran, and a combination thereof.
22. The cushioning device of Claim 10, wherein:
- a) said core particles are coated with a surfactant and dispersed in a carrier fluid.

23. The cushioning device of Claim 22, wherein:
- a) said carrier fluid comprises a water-based or an oil-based carrier fluid.
24. The cushioning device of Claim 22, wherein:
- a) said carrier fluid is selected from the group consisting of water, hydraulic oil, mineral oil, silicone oil, biodegradable oil, and a combination thereof.
25. The cushioning device of Claim 22, wherein:
- a) the fraction of said core particles is about 1-95%.
26. The cushioning device of Claim 10, wherein:
- a) said core particles comprise a general shape selected from the group consisting of spherical, needle-like, cubic, irregular, cylindrical, diamond, oval, and a combination thereof.
27. A sole for a footwear, comprising:
- a) a chamber including a magnetically responsive fluid;
  - b) a magnetic member for applying a magnetic field to said fluid thereby varying the viscosity thereof; and

- c) a control unit for relaying a signal to said magnetic member to apply a magnetic field.
- 28. The sole of Claim 1, wherein:
  - a) the viscosity of said fluid is greater than the viscosity of a fluid selected from the group consisting of water, glycerine, hydraulic oil, and mineral oil.
- 29. The sole of Claim 27, further comprising:
  - a) a weight sensor for determining the weight of a user of a footwear.
- 30. The sole of Claim 27, further comprising:
  - a) a movement sensor for determining the movement of a footwear.
- 31. The sole of Claim 29, wherein:
  - a) said control unit receives information from said weight sensor for relaying a signal to said magnetic member to apply a magnetic field.

32. The sole of Claim 31, wherein:
- a) the strength of a magnetic field applied by said magnetic member is proportional to the weight of a user.
33. The sole of Claim 27, wherein:
- a) said fluid comprises core particles of a magnetic material.
34. The sole of Claim 33, wherein:
- a) a plurality of said core particles form a magnetically connected structure when a magnetic field is applied to said fluid.
35. The sole of Claim 34, wherein:
- a) said structure comprises a generally rectilinear or bent configuration.
36. The sole of Claim 35, wherein:
- a) said structure is oriented in a generally vertical direction.
37. The sole of Claim 27, wherein:
- a) the sole comprises toe and heel portions each including one said chamber.



38. The sole of Claim 37, wherein:
- a) each of said toe and heel portions includes one said magnetic member.
39. The sole of Claim 38, wherein:
- a) the strengths of the magnetic fields applied by the magnetic members of said toe and heel portions may be substantially the same or different.
40. The sole of Claim 38, wherein:
- a) the magnetic members of said toe and heel portions apply magnetic fields substantially simultaneously or at different times.
41. The sole of Claim 33, wherein:
- a) said core particles comprise coated particles.
42. The sole of Claim 33, wherein:
- a) said core particles have an average diameter of about 1 nm to 100  $\mu\text{m}$ .

43. The sole of Claim 42, wherein:
- a) said core particles have an average diameter of about 1 nm to 10  $\mu\text{m}$ .
44. The sole of Claim 43, wherein:
- a) said core particles have an average diameter of about 10 nm to 5  $\mu\text{m}$ .
45. The sole of Claim 33, wherein:
- a) said magnetic material is selected from the group consisting of iron, iron oxide, cobalt, cobalt oxide, nickel, nickel oxide, an alloy, and a combination thereof.
46. The sole of Claim 33, wherein:
- a) said core particles comprise a coating of a surfactant.
47. The sole of Claim 46, wherein:
- a) said surfactant is selected from the group consisting of polyethylene glycol, lecithin, oleic acid, Surfynol<sup>®</sup>, and a combination thereof.

48. The sole of Claim 33, wherein:
- a) said core particles comprise a coating selected from the group consisting of a ceramic material, a metallic material, a polymer material, and a combination thereof.
49. The sole of Claim 48, wherein:
- a) the coating is selected from the group consisting of silica, gold, silver, platinum, steel, cobalt, carbon, polyethylene glycol, polystyrene, dextran, and a combination thereof.
50. The sole of Claim 33, wherein:
- a) said core particles comprise first and second successive coatings.
51. The sole of Claim 50, wherein:
- a) said first coating comprises a coating of a surfactant; and
  - b) said second coating comprises a coating of a material selected from the group consisting of a ceramic material, a metallic material, a polymer material, and a combination thereof.

52. The sole of Claim 51, wherein:
- a) said surfactant is selected from the group consisting of polyethylene glycol, lecithin, oleic acid, Surfynol<sup>®</sup>, and a combination thereof.
53. The sole of Claim 52, wherein:
- a) said second coating is selected from the group consisting of silica, gold, silver, platinum, steel, cobalt, carbon, polyethylene glycol, polystyrene, dextran, and a combination thereof.
54. The sole of Claim 42, wherein:
- a) said core particles are coated with a surfactant and dispersed in a carrier fluid.
55. The sole of Claim 54, wherein:
- a) said carrier fluid comprises a water-based or an oil-based carrier fluid.

56. The sole of Claim 54, wherein:
- a) said carrier fluid is selected from the group consisting of water, hydraulic oil, mineral oil, silicone oil, biodegradable oil, and a combination thereof.
57. The sole of Claim 54, wherein:
- a) the fraction of said core particles is about 1-95%.
58. The sole of Claim 42, wherein:
- a) said core particles comprise a general shape selected from the group consisting of spherical, needle-like, cubic, irregular, cylindrical, diamond, oval, and a combination thereof.
59. A sole for a footwear, comprising:
- a) a chamber including a magnetically responsive fluid;
  - b) an electromagnet for applying a magnetic field to said fluid thereby varying the viscosity thereof;
  - c) a movement sensor for determining the movement of a footwear;
  - d) a weight sensor for determining the weight of a user of a footwear; and

- e) a control unit for receiving information from one of said movement and weight sensors and relaying a signal to said electromagnet for applying a magnetic field.

60. The sole of Claim 59, wherein:

- a) the viscosity of said fluid is greater than the viscosity of a fluid selected from the group consisting of water, glycerine, hydraulic oil, and mineral oil.

61. The sole of Claim 59, wherein:

- a) the strength of a magnetic field applied by said magnetic member is proportional to the weight of a user.

62. The sole of Claim 59, wherein:

- a) said fluid comprises core particles of a magnetic material.

63. The sole of Claim 62, wherein:

- a) a plurality of said core particles form a magnetically connected structure when a magnetic field is applied to said fluid.

64. The sole of Claim 63, wherein:
- a) said structure comprises a generally rectilinear or bent configuration.
65. The sole of Claim 64, wherein:
- a) said structure is oriented in a generally vertical direction.
66. The sole of Claim 59, wherein:
- a) the sole comprises toe and heel portions each including one said chamber.
67. The sole of Claim 66, wherein:
- a) each of said toe and heel portions includes one said magnetic member.
68. The sole of Claim 67, wherein:
- a) the strengths of the magnetic fields applied by the magnetic members of said toe and heel portions may be substantially the same or different.

69. The sole of Claim 67, wherein:
- a) the magnetic members of said toe and heel portions apply magnetic fields substantially simultaneously or at different times.
70. The sole of Claim 62, wherein:
- a) said core particles comprise coated particles.
71. The sole of Claim 62, wherein:
- a) said core particles have an average diameter of about 1 nm to 100  $\mu\text{m}$ .
72. The sole of Claim 71, wherein:
- a) said core particles have an average diameter of about 1 nm to 10  $\mu\text{m}$ .
73. The sole of Claim 72, wherein:
- a) said core particles have an average diameter of about 10 nm to 5  $\mu\text{m}$ .



74. The sole of Claim 62, wherein:
- a) said magnetic material is selected from the group consisting of iron, iron oxide, cobalt, cobalt oxide, nickel, nickel oxide, an alloy, and a combination thereof.
75. The sole of Claim 62, wherein:
- a) said core particles comprise a coating of a surfactant.
76. The sole of Claim 75, wherein:
- a) said surfactant is selected from the group consisting of polyethylene glycol, lecithin, oleic acid, Surfynol<sup>®</sup>, and a combination thereof.
77. The sole of Claim 62, wherein:
- a) said core particles comprise a coating selected from the group consisting of a ceramic material, a metallic material, a polymer material, and a combination thereof.
78. The sole of Claim 77, wherein:
- a) the coating is selected from the group consisting of silica, gold, silver, platinum, steel, cobalt, carbon, polyethylene glycol, polystyrene, dextran, and a combination thereof.

79. The sole of Claim 62, wherein:
- a) said core particles comprise first and second successive coatings.
80. The sole of Claim 79, wherein:
- a) said first coating comprises a coating of a surfactant; and
  - b) said second coating comprises a coating of a material selected from the group consisting of a ceramic material, a metallic material, a polymer material, and a combination thereof.
81. The sole of Claim 80, wherein:
- a) said surfactant is selected from the group consisting of polyethylene glycol, lecithin, oleic acid, Surfynol<sup>®</sup>, and a combination thereof.
82. The sole of Claim 81, wherein:
- a) said second coating is selected from the group consisting of silica, gold, silver, platinum, steel, cobalt, carbon, polyethylene glycol, polystyrene, dextran, and a combination thereof.

83. The sole of Claim 71, wherein:
- a) said core particles are coated with a surfactant and dispersed in a carrier fluid.
84. The sole of Claim 83, wherein:
- a) said carrier fluid comprises a water-based or an oil-based carrier fluid.
85. The sole of Claim 83, wherein:
- a) said carrier fluid is selected from the group consisting of water, hydraulic oil, mineral oil, silicone oil, biodegradable oil, and a combination thereof.
86. The sole of Claim 83, wherein:
- a) the fraction of said core particles is about 1-95%.
87. The sole of Claim 71, wherein:
- a) said core particles comprise a general shape selected from the group consisting of spherical, needle-like, cubic, irregular, cylindrical, diamond, oval, and a combination thereof.

88. The cushioning device of Claim 4, further comprising:
- a) a control unit for receiving information from said movement sensor and relaying a signal to said magnetic member to apply a magnetic field.
89. The sole of Claim 30, wherein:
- a) said control unit receives information from said movement sensor for relaying a signal to said magnetic member to apply a magnetic field.
90. The sole of Claim 89, wherein:
- a) the strength of a magnetic field applied by said magnetic member depends on a type of movement detected by said movement sensor.
91. The sole of Claim 90, wherein:
- a) the type of movement is selected from the group consisting of walking, brisk walking, jogging, running, jumping, stepping, and skipping.

92. The sole of Claim 59, wherein:
- a) said control unit receives information from both of said movement and weight sensors.
93. The sole of Claim 59, wherein:
- a) the strength of a magnetic field applied by said magnetic member depends on a type of movement detected by said movement sensor.
94. The sole of Claim 93, wherein:
- a) the type of movement is selected from the group consisting of walking, brisk walking, jogging, running, jumping, stepping, and skipping.
95. The cushioning device of Claim 10, wherein:
- a) said core particles comprise a plurality of groups of particles having different average diameters.
96. The sole of Claim 42, wherein:
- a) said core particles comprise a plurality of groups of particles having different average diameters.

97. The sole of Claim 71, wherein:
- a) said core particles comprise a plurality of groups of particles having different average diameters.
98. A method of varying the shock absorbing capacity of a footwear cushioning device, comprising:
- a) providing a cushioning device, comprising:
    - i. a chamber including a magnetically responsive fluid; and
    - ii. a magnetic member for applying a magnetic field to the fluid;
  - b) applying a magnetic field to the fluid based on an input to thereby vary the viscosity of the fluid; and
  - c) whereby a change in viscosity of the magnetic fluid changes the shock absorbing capacity of the cushioning device.
99. The method of Claim 98, wherein:
- the input in step b) comprises weight data for a user received from a weight sensor.

100. The method of Claim 98, wherein:

the input in step b) comprises movement data for a footwear received from a movement sensor.